REMARKS

The final Examiner's Office Action dated February 10, 2003 has been received and its contents reviewed. Claims 1-14 are pending in the instant application. By this Amendment, claim 1 has been amended to recite the step of "manufacturing a master mask having an aperture of a pattern identical with the object mask by using an electron beam exposure apparatus" which is discussed in detail at page 6, lines 7-20. Specifically, the claimed process includes forming first a master mask and then a child mask using a "conventional electron beam exposure apparatus" to form the master mask which is then followed by employing an "electron beam proximity exposure apparatus" to form each of the child masks. See also Figure 2, elements 101 and 102. In view of these actions and the following remarks, reconsideration of this application is requested.

With regard to the Examiner's continued rejection of:

Claims 1 and 8, under 35 U.S.C. §102(b), as anticipated by Livesay et al. ('916),

Claims 1 and 8, under 35 U.S.C. §102(b), as anticipated by Randall ('138),

Claims 3 and 10, under 35 U.S.C. §103(a), as being obvious in view of the teachings of Randall ('138),

Claims 2, 4, 9 and 11, under 35 U.S.C. §103(a), as being obvious in view of the teachings of Randall ('138) combined with the teachings of Owen et al. (265), and

Claims 5-7 and 12-14, under 35 U.S.C. §103(a), as being obvious in view of the teachings of Randall ('138) combined with the teachings of Dick et al. ('680).

Each of these rejections is respectfully traversed at least for the reasons provided below.

Claim 1 of the present invention represents a technique for producing a child mask by an electron beam proximity exposure apparatus in which a mask having been

produced by a mask writer, that is a conventional electron beam exposure apparatus, is used as a master mask. In this embodiment, the conventional electron beam exposure apparatus corresponds to a mask producing apparatus (denoted with a reference number 101) in the specification; while the electron beam proximity exposure apparatus corresponds to a device wafer producing apparatus (denoted with a reference number 102) in the specification. The later apparatus is also clearly recited in the preamble of claim 1 and again in the body of claim when forming the child mask.

The two apparatus, i.e., the electron beam exposure apparatus (i.e., mask writer) and electron beam proximity exposure apparatus, are substantially different in structure and operation as pointed out by the "High Throughput Submicron Lithography with Electron Beam Proximity Printing" article by H. Bohlen et al, Solid State Technology (1984). The prior art conventionally employs only one method for producing a mask. That is, by the employing an electron beam exposure apparatus (mask writer) whenever required regardless of whether the mask to be produced is master mask or a child mask. In contrast, the present invention presents in claim 1 a method for producing number of child masks from one master mask by the use of the electron beam proximity exposure apparatus normally used for wafer device exposure.

The Applicants believe that the technique disclosed in the present invention for producing the child masks differs from that disclosed in Livesay in that the present invention uses the electron beam proximity exposure apparatus (a device wafer producing apparatus) to prepare the child mask whereas Livesay employs a conventional "electron beam pattern generator" (column 5, lines 10-16; column 6, lines 22-28), i.e., mask writer, for production of both the master and child masks. Therefore, since Livesay does not teach (implicitly or explicitly) employing two separate differently structured apparatus to prepare the master and child masks, anticipation has not been established and the rejection of claims 1 and 8, under § 102, is improper and must be withdrawn.

With regard to the Randall reference, the disclosure of Randall noted by the Examiner, i.e., column 5, lines 39-50, describes producing a mask in a serial writing mode via an electron beam method, and the mask produced thereby is used as the master mask to produce all the future masks in an ion-beam method. As described above, although there are a conventional "serial" mask producing electron beam exposure apparatus and a "currently-used" mask producing "parallel writing" electron beam exposure apparatus, discussed in Randall (column 1, lines 28-40) both of which are the electron beam type, the productivities of each apparatus are very different: the conventional serial apparatus has a much lower productivity than the currently-used parallel writing apparatus. However, the parallel writing apparatus suffers from dimensional control problems due to the proximity effect.

This is the reason Randall had to limit the exposure method to producing the future masks with an exposure tool of the ion-beam type. More Specifically, Randall realizes the technical problems encountered when using either serial writing or parallel writing apparatus in producing exposure masks, and thus Randall avoids explaining in detail the difficulty in applying the electron beam method to both the master and child masks. Instead, Randall employs the ion-beam type apparatus to produce the child masks. Such a teaching clearly imparts to one of ordinary skill in the prior art that utilizing the electron beam method to produce the child masks was not possible or desirable at the time of the invention of Randall. In contrast, the invention recited in claims 1 and 8 of the present invention solves the above-described problem and thereby prepares the future masks by using the wafer device producing electron beam proximity exposure apparatus (and not the mask producing electron beam exposure apparatus). This feature totally differs from the teachings of Randall.

Further, the Examiner asserts that using the second mask or using each previous mask as a master mask to fabricate the next mask would have been obvious to one of ordinary skill in the art employing an electron beam apparatus. However, the present invention is not directed to a concept of copying the masks. In the

presently claimed invention, if a master mask is fabricated by the mask producing apparatus, that is, the electron beam exposure apparatus, i.e., "mask writer", the child masks to be fabricated after the initial master mask will be copied by a wafer device producing apparatus (an electron beam proximity exposure apparatus). In contrast, Randall teaches that the ion-beam type exposure apparatus should be used, and further, the patentee nowhere suggests that two different electron beam apparatus, as presently claimed, should be used to produce the master mask and then the child mask. Since Randall does not teach each feature of the presently claimed invention or suggest modifying the process/apparatus disclosed therein to achieve the method presently claimed the rejections of claims 1 and 8, under § 102, and claims 3 and 10, under § 103, are believed to have been set forth in error and should now be withdrawn.

A review of the Owen et al. and Dick et al. references reveals that each disclosure does not contain a teaching with remedies the deficiencies of Randall noted above. It is true that compensation for the reduction in resolution due to the proximity effect, per Owen et al., and the sub-deflection technology, per Dick et al., is commonly known; however, in the method of the present invention, precision by the sub-deflection technology is improved in the mask producing procedure presently claimed wherein two separate electron beam apparatus are employed.

Further, correction of sub-deflection in Dick et al. relates to the master mask producing apparatus. The present invention achieves correction on the wafer device producing apparatus for compensating the productivity as well as precision of the child mask produced and not the master mask. For the above reasons, the combinations of Randall and either Owen et al. or Dick et al. would not have made the present invention obvious to one of ordinary skill in the art. Therefore, the rejections of claims 2, 4-7, 9 and 11-14, under § 103, over the combination of teachings of Randall and Owen et al. or Dick et al. are also believed to have been set forth in error and must also be withdrawn.

Finally, the Examiner asserts, in the Response to Arguments sections 26. and 28. of the Office Action, that lithography (regardless of the type, i.e., ion-beam, X-ray, e-beam, is an object pattern producing means (for masks). The Applicants wholeheartedly disagree with this assertion by the Examiner, and the Examiner is respectfully requested to provide technical evidence to support this assertion. In contrast to the Examiner's assertion, the Applicants assert that those of ordinary skill in the prior art (see the Bohlen et al article above) realize that there are two types of lithographies:

- lithography used for a mask manufacturing and
- lithography used for device manufacturing,

which differ in the structure of the apparatus and methodologies employed in each.

In the present invention, child mask manufacturing and device manufacturing are performed by the same apparatus (refer to U.S. Patent No. 5,831,272 directed to an electron beam proximity exposure apparatus).

Further, the Examiner also states, at section 27., that "... Randall's statements of the problems associated with electron beam lithography (col. 1, lines 29-39) are specifically related to use in a serial mode."; however, a careful review of that portion of Randall, reveals that the patentee also teaches "...parallel-printing with electron beam lithography is capable of high resolution, it has critical dimension control problems due to a proximity effect inherent in the electron beam process." Therefore, Randall clearly discloses that an application of the electron beam parallel printing (as well as serial printing) is difficult for the production of patterns during fabrication of integrated circuits.

While the present application is now believed to be in condition for allowance, should the Examiner find some issue to remain unresolved, or should any new issues arise, which could be eliminated through discussions with Applicants' representative,

then the Examiner is invited to contact the undersigned by telephone in order that the further prosecution of this application can thereby be expedited.

Lastly, it is noted that a separate Extension of Time Petition (one month) accompanies this response along with a check in payment of the requisite extension of time fee. However, should that petition become separated from this Amendment, then this Amendment should be construed as containing such a petition. Likewise, any overage or shortage in the required payment should be applied to Deposit Account No. 19-2380 (740107-135).

Respectfully submitted,

By: _____

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